2(mix)

NTIS $4.75

E7.2 - 1 0.3 62

CR-129692

(E72-10362) THE INTERDEPENDENCE OF LAKE ICE AND CLIMATE IN CENTRAL NORTH AMERICA Interim Report, Jun. - Nov. 1972 A.J. Jelacic (Wolf Research and Development Corp.) Dec. 1972 54 p CSCL 08L G3/13

N73-14350

Unclas
00362

W
O
L
F

RESEARCH AND DEVELOPMENT CORPORATION

AN EG&G COMPANY

54

THE INTERDEPENDENCE OF LAKE ICE AND CLIMATE IN CENTRAL NORTH AMERICA

Prepared For:	National Aeronautics and Space Administration Goddard Space Flight Center Greenbelt, Maryland 20771
Prepared By:	Allan J. Jelacic Wolf Research and Development Corporation 6801 Kenilworth Avenue Riverdale, Maryland 20840
Type:	Interim Report for Period June - November 1972
Date Prepared:	December 1972

1. Report No.

2. Government Accession No.

3. Recipient's Catalog No.

4. Title and Subtitle

The Interdependence of Lake Ice and Climate in Central North America.

5. Report Date

December 1972

6. Performing Organization Code

7. Author(s)

Allan Jelacic, Consultant

8. Performing Organization Report No.

9. Performing Organization Name and Address

Wolf Research and Development Corporation
6801 Kenilworth Avenue
Riverdale, Maryland 20840

10. Work Unit No.

11. Contract or Grant No.

NAS 5–21761

12. Sponsoring Agency Name and Address

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Arthur W. Fihelly

13. Type of Report and Period Covered

Interim: June–November 1972

14. Sponsoring Agency Code

15. Supplementary Notes

None

16. Abstract

This report covers all work performed during the first two phases of the investigation: (1) Prelaunch Preparation and (2) "First Look" Data Analysis. The process of selecting major study lakes is discussed, and a complete lake directory is presented. Various routines of the software support library are described, accompanied by output samples. The procedures used for ERTS imagery processing after receipt from NASA are presented along with the Data Analysis Plan. Application of these procedures to selected ERTS imagery has demonstrated their utility. Preliminary results show that the freeze/thaw transition zone can be monitored from ERTS.

17. Key Words (Selected by Author(s))

lake ice, ice survey, meteorology

18. Distribution Statement

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
U	*U*		

**For sale by the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.*

TECHNICAL REPORT STANDARD TITLE PAGE

PREFACE

The primary objective of this investigation is to identify any correlations between the freeze/thaw cycles of lakes and regional weather variations. To meet this objective ERTS 1 imagery of central Canada and north central United States are examined on a seasonal basis. The ice conditions of certain major study lakes are noted and recorded on magnetic tape, from which the movement of a freeze/thaw transition zone may be deduced. Weather maps and tables are used to establish any obvious correlations.

All work accomplished to date has been directed towards meeting the above objective. An efficient means of cataloging ERTS imagery has been devised along with a very effective Data Analysis Plan. Tasks associated with data processing and analysis are supported by an extensive software library. Preliminary results on selected ERTS imagery have demonstrated the feasibility of the approach and hold out great promise for future efforts.

LIST OF TABLES

LIST OF FIGURES

SECTION 1.0
INTRODUCTION

This report is a comprehensive review of all work performed under contract number NAS 5-21761 since the inception of the contract in May 1972. The presentation will be in approximate chronological order and will consist of a detailed breakdown of accomplishments during the first two scheduled phases of this project:

1. Prelaunch Preparation

2. "First Look" Data Analysis

A certain degree of overlap has resulted from the performance of these preliminary phases and several tasks from each are still active at the present time. Although work on these tasks will continue into the Phase (3) period of the investigation, the nature of the work is such that no delay in the orderly progress of the investigation is anticipated. All tasks, both complete and incomplete, will be presented below.

SECTION 2.0
PRELAUNCH PREPARATION

2.1 STUDY LAKE SELECTION

A requisite portion of this project was the identification and selection of major study lakes. Study lakes are those lakes within the test site whose ice condition will be monitored using ERTS 1 imagery. In order to facilitate the process, two criteria were adopted by which a lake may qualify for selection:

- Availability of morphometric data,
- Availability of freeze-thaw information.

Morphometric data was defined as surface area, mean depth, and maximum depth, whereas freeze-thaw information was taken to include any historic and/or up-to-date freeze and thaw dates.

A number of potential study lakes were found in the open literature (1,2,3,4,5). In addition, requests for aid were sent to responsible government officials at the state and federal levels, such as the Wisconsin Department of Natural Resources and the U.S. Army Corps of Engineers (Omaha District). Comparable province and federal officials in Canada were also contacted. On the whole, responses to the letter campaign were excellent. The Atmospheric Environment Service of Canada was particularly helpful in supplying updated freeze-thaw information from their own rather extensive lake ice survey.

A master list of candidate lakes was compiled from the available sources with each entry containing all or part of the following information:

- lake name
- location (latitude, longitude, state/province)
- morphometry
- freeze-thaw history.

Using the aforementioned criteria as a basis for selection, approximately 65 percent of the candidate lakes were chosen as study lakes. In order to be selected each study lake had to be located and positively identified on an Operational Navigation Chart (ONC), scale, 1:1,000,000. This requirement eliminated nearly all lakes with surface areas less than about 2 square kilometers. Inaccurate or nonexistent location data were also a critical factor in the selection process.

The geographical distribution of all candidate and study lakes is shown in Table 1. As reflected by the table, Wisconsin proved to be the best source of data. Unexpectedly little information about Michigan and Minnesota lakes was discovered during the Prelaunch Phase. In general, aside from Wisconsin, few readily accessible sources of limnological information about United States lakes seem to exist. The opposite may be stated of Canada, although here too the availability of information required for this study was limited in relation to the number of lakes.

2.2 SOFTWARE DEVELOPMENT

The following sub-tasks describe the various steps taken in developing the production processing software to be

Table 1. Geographical Breakdown of Candidate Lakes and Study Lakes Selected for use in the Lake Ice Investigation

Country	State/Province	Candidate Lakes	Study Lakes
CANADA	Northwest Territories	33	22
	Alberta	8	7
	Saskatchewan	52	27
	Manitoba	41	35
	Ontario	24	14
	Sub-Total	158	105
UNITED STATES	Illinois	15	10
	Indiana	6	4
	Iowa	8	4
	Michigan	21	5
	Minnesota	5	3
	Nebraska	31	15
	North Dakota	6	5
	South Dakota	11	11
	Wisconsin	150	106
	Sub-Total	253	163
	TOTAL	411	268

used during this investigation. The rationale for particular software development will be presented, however, program listings will be omitted from this report.

2.2.1 Lake Identification Code

In order to achieve maximum versatility for handling large quantities of data, each lake has been assigned an identification code. The code consists of six (6) characters, aabbbc, where aa is a location code indicating state or province, bbb is a unique lake sequence number for a given state or province, and c is a data descriptor indicating the type of information available for a given lake. Allowable identification symbols and their meaning are shown in Table 2. As an example consider the identification code 040332. According to Table 2 this lake is located in Manitoba (MAN) and is the 33rd lake from Manitoba to be catalogued. In addition, the data descriptor code, 2, indicates that both morphometric information and updated freeze/thaw dates are available for this lake. (In this report "updated" means the 1971-72 winter season.)

Thus, a unique identification code number exists for each candidate lake in the investigation. New lakes may be added at any time by the assignment of a number, and even lakes for which no morphometry or freeze/thaw data are available may be included by using the descriptor code 0. Furthermore, the lake identification code offers a convenient, standardized means of annotating the ONC maps to be used during data analysis. In this regard all study lakes were recorded on such maps by their identification code.

Table 2. Lake Identification Code (aabbbc), Allowable Symbols and Their Definition

Location Code (aa)

Code	State/Province	Symbol
01	Northwest Territories	NWT
02	Alberta	ALB
03	Saskatchewan	SAS
04	Manitoba	MAN
05	Ontario	ONT
06	Illinois	ILL
07	Indiana	IND
08	Iowa	IWA
09	Michigan	MCH
10	Minnesota	MIN
11	Nebraska	NEB
12	North Dakota	NDA
13	South Dakota	SDA
14	Wisconsin	WIS

Sequence Number Code (bbb)

Allowable range: 001-999

Data Descriptor Code (c)

Code	Morphometry	Updated Freeze/Thaw Information	Historic Freeze/Thaw Information
0	-	-	-
1	X	-	-
2	X	X	-
3	X	-	X
4	-	X	-
5	-	-	X

2.2.2 Lake History Processing Programs

All lake data collected during the Prelaunch Phase, including morphometry and freeze/thaw dates, will subsequently be referred to as "lake history."

In order to assume adequate handling of all lake history data, a series of short programs were written and debugged on the GSFC IBM 360/91 computer in FORTRAN IV. Taken totally, these programs accept card-punched lake history data, load that data onto a magnetic tape storage file, and printer output all or selected portions of that file at the user's discretion. The Lake History File (LHF) is ordered sequentially by lake identification number; typical output data sets from the LHF are shown in Figure 1.

One particular program in this series has the ability to search the LHF for all records which meet a user supplied set of criteria. These criteria may include one or more of the following:

- State/province. All lakes within any one or more of the 14 states or provinces which make up the test site.
- Location. All lakes within a polygon-shaped area with from 3 to 8 sides.
- Morphometry. All lakes whose area and/or mean depth and/or maximum depth lie within a specified range.
- Freeze/Thaw. A certain percentage of all lakes whose freeze/thaw dates fall within a specified time range.

```
84.  NAME OF LAKE: UNION                     ID CODE:  090071
     STATE/PROV:   MCH
     LAT:   42  3 N     AREA:    1.88      MAX DEPTH:    0.0
     LONG:  85 12 W              (SQ KM)   MEAN DEPTH:   8.7
                                                     (METERS)

     FREEZE/THAW HISTORY          NUMBER OF ENTRIES:     0

              DATE CLOSED      DATE OPEN
                 >>>>> END RECORD <<<<<


85.  NAME OF LAKE: BEAR                      ID CODE:  090103
     STATE/PROV:   MCH
     LAT:   44 48 N     AREA:    0.47      MAX DEPTH:   16.2
     LONG:  84 37 W              (SQ KM)   MEAN DEPTH:   5.2
                                                     (METERS)

     FREEZE/THAW HISTORY          NUMBER OF ENTRIES:     5

              DATE CLOSED      DATE OPEN
              DEC 18  1949     MAR 25  1950
              DEC 15  1950     MAR  1  1951
              DEC 22  1951     MAR 12  1952
              DEC 30  1952     FEB 28  1953
              DEC 20  1953     FEB 22  1954
                 >>>>> END RECORD <<<<<


86.  NAME OF LAKE: BIG PORTAGE               ID CODE:  090113
     STATE/PROV:   MCH
     LAT:   42 19 N     AREA:    1.46      MAX DEPTH:   12.2
     LONG:  84 15 W              (SQ KM)   MEAN DEPTH:   3.3
                                                     (METERS)

     FREEZE/THAW HISTORY          NUMBER OF ENTRIES:     9

              DATE CLOSED      DATE OPEN
              DEC 18  1949     MAR 25  1950
              DEC 12  1950     MAR  5  1951
              DEC 20  1951     MAR 13  1952
              DEC 28  1952     FEB 26  1953
              DEC 22  1953     FEB 22  1954
              DEC 16  1954     MAR 10  1955
              DEC 15  1955     MAR 16  1956
              JAN  1  1957     MAR 12  1957
              JAN  1  1958     MAR 25  1958
                 >>>>> END RECORD <<<<<
```

Figure 1. Lake History File (Sample Output)

B

Some clarification as to the function of this program may be obtained from the examples given in Figures 2 and 3. Figure 2 shows the results of a search made for any lakes in Alberta and Saskatchewan which also lie within the boundaries of the rectangular polygon defined by the geographical coordinates; Figure 3 includes all lakes whose freeze dates fall between November 15 and November 30 for every freeze observation. This versatile software is expected to be of considerable assistance during data analysis. Additional analysis aid will be supplied by another program which calculates early, late, and mean freeze/thaw dates, as well as deviations, for all study lakes.

2.2.3 Lake Observation Processing Programs

During the Prelaunch Phase the processing software for all lake observations made from ERTS imagery was developed. This program package is, in many respects, similar to that for lake history. A magnetic tape file, called the Lake Observation File (LOF), was created to store all observation data sets. An observation data set consists of the following:

- observation date (equivalent to imagery date)
- image identification number
- lake name
- lake identification code
- latitude
- longitude
- state/province
- observation code
- comments

[redacted]THE[redacted]AKE[redacted]STO[redacted]FI[redacted]WAS[redacted]AR[redacted]C F[redacted]REC[redacted]DS [redacted]CH [redacted]TA[redacted]SPE[redacted]IE[redacted]NFO[redacted]TI[redacted]
THAT INFORMATION IS INDICATED AS FOLLOWS

STATE/PROVINCE: ALB SAS
LOCATION: 5500N LAT 10500W LONG
5500N LAT 12500W LONG
6000N LAT 12500W LONG
6000N LAT 10500W LONG

	LAKE NAME	ID CODE	LOC	LATITUDE DEG MIN	LONGITUDE DEG MIN	AREA (SQ KM)	MEAN DEPTH (METERS)	MAX DEPTH (METERS)
1	ATHABASCA	020044	ALB	5843	11109	0.0	0.0	0.0
2	BEAR	020054	ALB	5511	11853	0.0	0.0	0.0
3	LESSER SLAVE	020074	ALB	5521	11459	0.0	0.0	0.0
4	FROBISHER	030011	SAS	5619	10757	313.0	5.5	19.0
5	MCINTOSH	030071	SAS	5550	10500	60.7	12.8	45.5
6	BIG PETER POND	030371	SAS	5600	10850	552.0	13.7	24.0
7	LITTLE PETER PON	030381	SAS	5547	10835	189.0	5.1	9.5
8	ILE A LA CROSSE	030391	SAS	5527	10750	446.0	8.2	27.0
9	CHURCHILL	030422	SAS	5550	10830	433.0	9.0	21.0
10	CREE	030432	SAS	5721	10708	1155.0	14.9	60.0
11	LAC LA RONGE	030442	SAS	5508	10520	1178.0	12.7	38.0
12	BEAVERLODGE	030472	SAS	5934	10829	47.7	30.5	70.0

FILE SEARCH COMPLETED FOR SPECIFIED INFORMATION

Figure 2. Lake History Search Program Results (Example 1)

[redacted]THE[redacted]KE [redacted]TO[redacted]IL[redacted]AS[redacted]ARC[redacted] F[redacted]REC[redacted]S W[redacted]H [redacted]TAI[redacted]PE[redacted]ED[redacted]FOR[redacted]IC[redacted]
THAT INFORMATICN ?S INDICATED AS FOLLCWS

FREI ZE/THAW: 1115 TO 1131, 100 PERCENT OF KNOWN DATES

	LAKE NAME	ID CODE	LOC	LATITUDE DEG MIN	LONGITUDE DEG MIN	AREA (SQ KM)	MEAN DEPTH (METERS)	MAX DEPTH (METERS)	F/T HISTORY CLOSE	F/T HISTORY OPEN
1	RANDOLPH	050024	ONT	5017	8854	0.0	0.0	0.0	0	50469
									112169	51770
2	PLATEAU	050044	ONT	4845	9137	0.0	0.0	0.0	112466	50567
									111567	50568
									112968	42869
									112069	50570
3	ARBOR VITAE	140023	WIS	4558	8939	4.2	0.0	8.8	113058	42059
									111659	0
4	CAMP	140043	WIS	4232	8808	1.0	0.0	6.0	0	33158
									112958	40359
5	ISLAND	140103	WIS	4608	8947	3.5	0.0	11.0	0	42149
									111949	51350
									0	50351
									0	42552
									112252	41653
									112753	42154
									113054	41855
									0	42356
									111756	42457
									112557	0
6	SUMMIT	140253	WIS	4628	9215	1.5	0.0	4.9	0	42158
									111758	42359
7	BONE	140353	WIS	4532	9223	8.3	0.0	15.0	112355	0
8	BROWNS	140373	WIS	4241	8815	1.6	0.0	7.0	0	40155
									112255	0
9	TURTLE	140453	WIS	4614	8915	5.8	0.0	14.5	112855	0

FILE SEARCH COMPLETED FOR SPECIFIED INFORMATION

Figure 3. Lake History Search Program Results (Example 2)

Data set contents will be discussed at greater length with examples, later in this report under the task, ERTS Imagery Processing. For the present suffice it to say that the LOF is organized sequentially in successive steps: first by observation date, then by image ID number, and lastly by lake ID code.

A utility program has also been written to search the LOF for records which satisfy a selected set of criteria. Essentially these criteria include any portion of the observation data set:

- Observation date. All observations whose date falls within a specified range.

- Lake identification code. All observations for lakes whose ID codes are specified.

- State/Province. All observations for lakes which belong to a specified state or province.

- Location. All observations for lakes which lie within a specified geographical area.

- Observation code. All observations which have a specified observation code.

The search program for the LOF functions in a manner similar to that for the LHF.

One other vital software routine requires mention here. That is the LOF Updating Program which accepts all observation data sets and inserts them in their proper location in the LOF. In addition to the above function this program also is responsible for maintaining and updating the Lake Directory File (LDF), an abbreviated version of the LHF containing only study lake location data. The entire study lake directory is presented in Appendix A.

2.2.4 <u>Data Analysis and Graphics Programs</u>

Software development pertinent to data analysis and graphics has not kept pace with that of the data processing programs. Due to unexpected delays, none of the software in this area was ready when the "First Look" Data Analysis Phase was initiated. Fortunately, this deficiency did not hamper data analysis; alternate manual procedures were developed and proved to be more than adequate substitutes. As a result, a number of the analysis and graphics programs which were scheduled for development have been deleted from the project. These include all graphics software which were to have provided contour plots, such as the transition zone map. None of the computational software, such as the running mean temperature calculation or the lake morphometry correlations, have been affected by this action, and work in this area is continuing.

2.3 METEOROLOGICAL DATA ACQUISITION

The prime objective of this study is to correlate lacustrine freeze/thaw cycles with weather variations. Consequently, the acquisition of a wide variety of meteorological data is indispensable to this objective. Such data includes air temperature, precipitation, wind velocity, and frontal patterns. To satisfy these requirements WOLF is receiving or has placed on order the following meteorological publications:

- Daily Weather Maps (Weekly Series)

- Monthly Climatological Data (by State)

- Monthly Record of Meteorological Observations in Canada

In addition, arrangements were made with NASA/GSFC Meteorology Branch to receive on loan North American Surface Charts. These charts are published daily and acquired at regular weekly intervals.

Obviously, when taken together the above publications present considerable data duplication. For example, air temperature is a parameter common to all of these sources. Data duplication was not a concern here, but rather the format in which the data appears. Those publications printed in tabular format are amenable to computer processing whereas map displays are useful in manual data analysis. Thus each weather data source serves a purpose.

SECTION 3.0
"FIRST-LOOK" DATA ANALYSIS

Much of the groundwork performed during the Prelaunch Phase has been utilized in the "First Look" Phase. This includes the detailed Data Analysis Plan which will be presented here in its entirety. In addition, some preliminary results of the Data Analysis Plan will be discussed and evaluated relative to their ability to meet this study's objectives.

3.1 ERTS IMAGERY PROCESSING

3.1.1 Scope of the Problem

As originally requested, the ERTS Standing Order with NASA/GSFC specifies that the Principal Investigator for this study receives one (1) copy (9.5 x 9.5 in., positive, b&w transparency, each band) of all imagery taken over the study area regardless of cloud cover. Study area boundaries are shown on Figure 4. The dotted lines represent the approximate daily ERTS 1 orbital tracks over the area. It can be readily observed that complete coverage requires the full 18-day ERTS cycle. A single picture-taking swath over the area can exceed 1500 statute miles, or about 16 ERTS scenes. When all swaths are considered, roughly 300 ERTS scenes are involved, and multiplying this by 4 MSS images per scene leads to a total of 1200 images received by the Principal Investigator every 18 days.

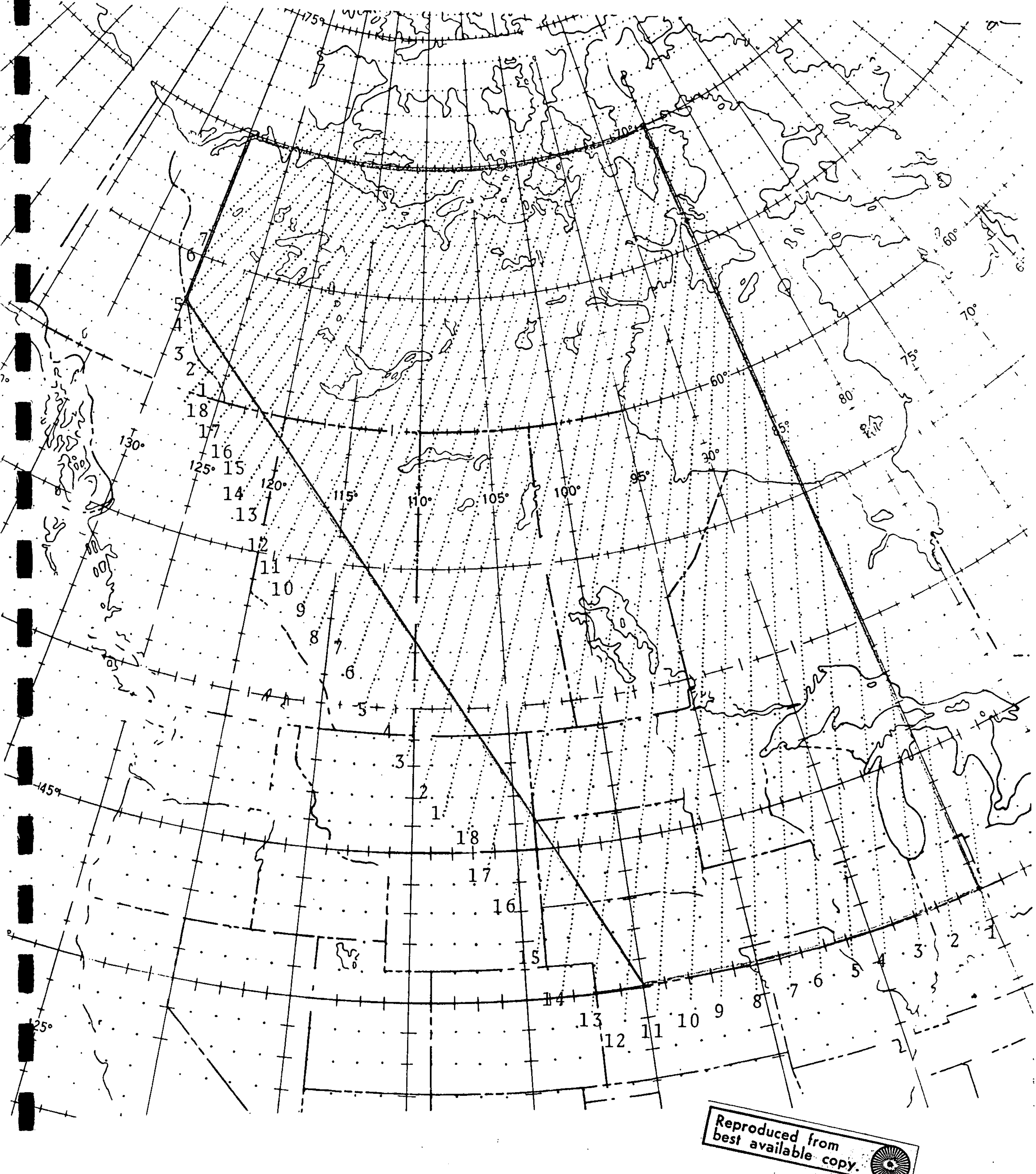


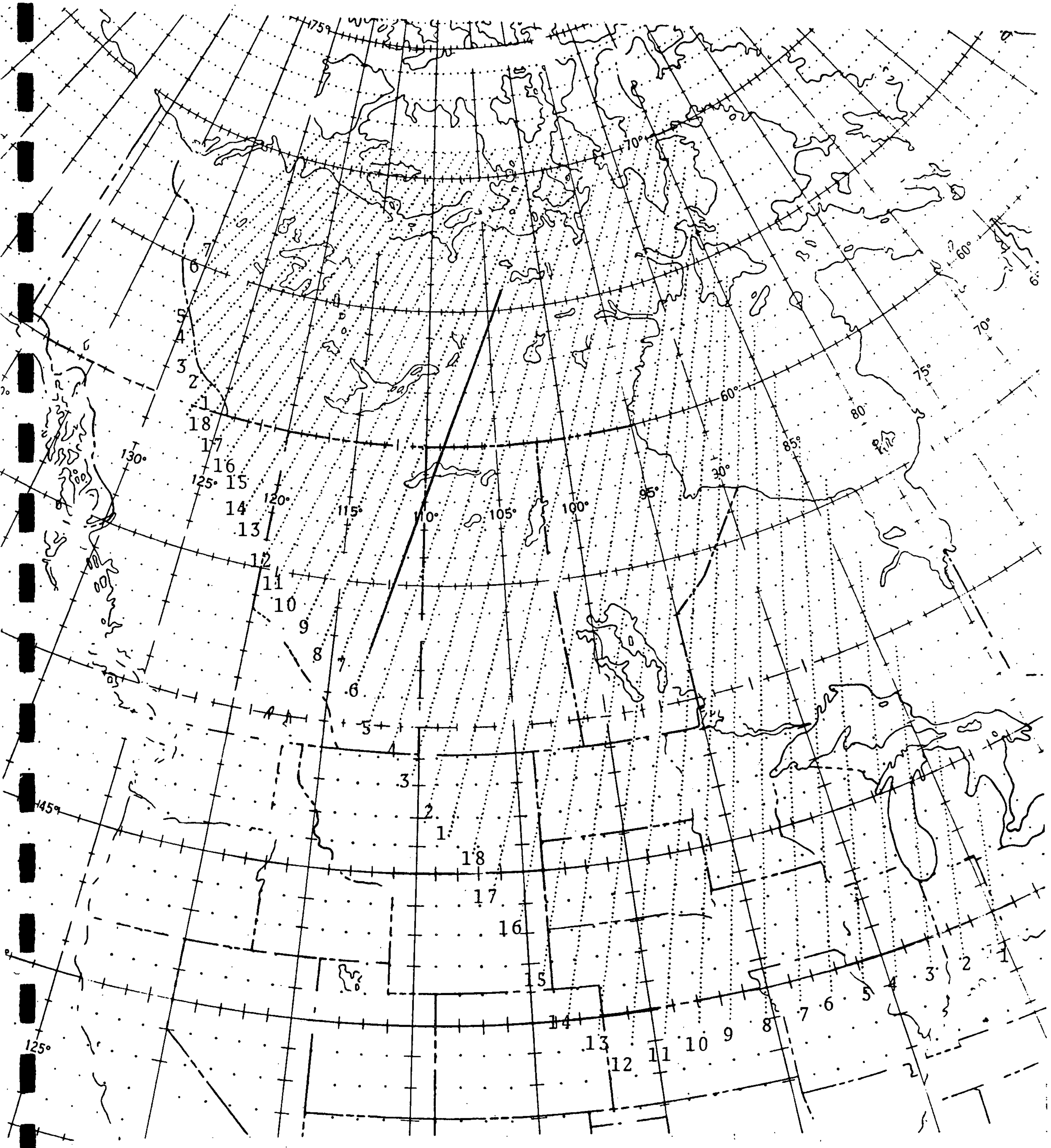
Figure 4. Lake Ice Study Area

The above figures translate into a prodigious imagery handling problem for the small group working on this investigation. However, a reasonably satisfactory procedure has been devised to minimize the handling problem while imparting a high degree of organization to the imagery.

3.1.2 Imagery Handling Procedure

To assure that all imagery is processed quickly and efficiently, an itemized filing schedule has been devised. This schedule is documented by a set of filing instructions which have been included here as Appendix B. In summary these instructions serve as a guide to the filing clerk for sorting, ordering, and recording all ERTS imagery received. Each data set or imagery swath is logged in by date of reception; the swath date is recorded as well. Images for a given swath are separated into spectral bands and ordered sequentially according to image ID number. This arrangement permits an analyst to easily examine all images in a swath for a particular band. After ordering, the images are placed in a glassine envelope and filed by swath date in individual legal-sized file folders.

The key to a workable imagery handling system is a simple but accurate procedure for recording the imagery prior to filing. Swath dates are recorded on the Image Log, but this supplies no information about areal coverage. For swath coverage a ground track map, such as that shown in Figure 5, is used. As indicated previously, the dotted lines on the map represent approximate ERTS surface traces, and the numbers indicate orbit days of the 18-day cycle. For this investigation cycle 1, day 1 was arbitrarily chosen 6 August 1972. As an example of how the map is utilized, suppose a swath



ERTS 1 GROUND TRACKS

CYCLE 1 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE AUG	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

Figure 5. ERTS 1 Ground Track Map

of imagery is received for 11 August 1972. The table at the bottom of the map indicates that this date corresponds to orbit day 6 of cycle 1 (see Figure 5). The geographical centerpoints of the first and last scenes of the swath may then be located on the map and plotted on orbit day 6. This recording procedure has proven to be fast, accurate, and sufficient to meet the needs of this investigation. The system provides an easy means of obtaining a quick inventory of all imagery on file.

3.2 ERTS IMAGERY ANALYSIS

Once imagery has been logged into the system, the task of imagery analysis can begin.

First, pertinent freeze/thaw data on study lakes must be extracted. In order to expedite this process, a Lake Observation Data Sheet (LODS) has been created (Figure 6). The LODS consists of 9 variable fields which total 80 columns, the normal length of a computer punch card. The nine LODS variables are:

1. <u>DATE</u>. The date on which the scene was taken. (Format: mmddyy, where mm = month; dd = day; yy = year).

2. <u>IMAGE</u>. Image number. For example, if the ERTS image identification number is E-1004-16360-3, the image number would be the last 4 digits of the exposure time or 6360. The image number in conjunction with the date is sufficient to uniquely identify every scene used in this investigation.

LAKE OBSERVATION DATA SHEET

DATE	IMAGE	LAKE NAME	ID CODE	LAT	LONG	S/P	OBS CODE	COMMENTS	
5	10	15 20 25	30 35	40	45		50	55 60 65 70 75	80

Figure 6. Lake Observation Data Sheet

3. LAKE NAME. Name of the lake in 16 digits or less.

4. ID CODE. Lake identification code in 6 digits or less.

5. LAT. Geographical latitude of lake. (Format: ddmm, where dd = degrees; mm = minutes).

6. LONG. Geographical longitude of lake. (Format: dddmm, where ddd = degrees; mm = minutes.)

7. S/P. State/province in which lake is located. (Format: aaa, where aaa = 3 letter state/ province abbreviation; see Table 2.)

8. OBS CODE. Lake observation code. Details are provided in Table 3.

9. COMMENTS. Any subjective comments relative to the observation or image in 27 digits or less.

When making a lake freeze/thaw observation from an image, the analyst first locates the lake on the annotated ONC maps. This task is relatively easy since the imagery and the maps are approximately equivalent in scale. If the lake is a study lake, that is, if the map is annotated with the lake identification number, the analyst simply makes an entry on the LODS. To be valid this entry need only contain the date, image number, lake ID number, and observation code. However, should there be no entry on the ONC map, the analyst must create one by assigning a lake identification

Table 3. Lake Observation Code

FREEZE/THAW CODES

Purpose: Lake freeze/thaw indicator code to be used on Lake Observation Data Sheet.

Format: The code consists of four (4) digits (AABB)
AA = Cloud Cover Code, indicating type of clouds over a lake, and their percentage of cover
BB = Ice Cover Code, indicating percentage of ice visible on lake

Cloud Cover Codes

First Digit	Meaning
A	No clouds in vicinity of lake
C	Cirrus - High level (20,000 feet ice crystals giving the appearance of a fine veil. Will be regarded as transparent.
F	Fog - Very low level coverage; resembles Stratus.
L	Multiple cloud layers.
S	Stratus - Solid deck of low level clouds; smooth in appearance.
Q	Cumulus - Convective, low level clouds; appear puffy.

Second Digit	
0 - 9	Lake free of cloud cover or shadows to lake 90% cloud covered.
N	Lake completely obscured by clouds; no ice state determination possible.

Ice Cover Codes

	Meaning
00 - 10	Percentage ice over - To range from lake completely ice free (00) to lake completely ice covered (10).
blank	No observation.

number, annotating the map, and filling in all information on the LODS exclusive of comments. Note that any lake entering the system in this manner has an identification number ending in 0.

After the LODS has been filled with observations, the entries are punched onto cards, and the data are placed in the LOF by means of the Lake Observation File Updating Program. The observation dates are now an integral part of the automated system with the punch cards and LODS serving as primary and secondary backups respectively.

In addition to the above data gathering procedure, which may be described as discrete point observation, the analyst has the option to graphically record his interpretations on a map similar to the one shown in Figure 4. This mode of data representation would be extremely useful for directly monitoring freeze/thaw transition zone variations in time and space.

3.3 DATA ANALYSIS

Much of the work associated with interpretation and analysis of the lake observation data can be accomplished simultaneously with imagery analysis. However, due to the one to two month lag in the delivery of weather data, a corresponding delay of at least that long in a complete data analysis must be expected.

As stated previously, the objective of this project is the investigation of the interaction of lake ice and climate, specifically the responses of the lake freeze/thaw transition zone to weather variations. As a result of the imagery analysis work, the migratory behaviour of the transition zone will have been documented over the entire freeze/thaw season. This information can be compared to weather data, such as temperature and precipitation, in either tabular or graphical form. The data should be abundant enough to allow any apparent correlations to be adequately tested.

The observed freezing sequences of the lakes should permit an estimate of their morphometry, which can be compared against that of lakes whose morphometry is known. Furthermore, by using the running mean air temperature method, the freezing dates of certain lakes may be predicted, and the imagery used to validate the predictions.

Much of the analysis outlined above will be accomplished with the assistance of computer software still under development. However, the bulk of the analytical effort will be done manually. This is not unexpected considering that images and maps are the primary working materials.

3.4 PRELIMINARY RESULTS

The Data Analysis Plan described in the previous sections has been implemented against all imagery received by the Principal Investigator bearing image dates on or after 6 August 1972. However, unexpected problems in image processing through the NDPF have produced delays in data reception of up to three months. As a result, concomitant delays in image processing and data analysis for this investigation have been experienced. In recent weeks the backlog has diminished as the number of imagery shipments increased, but large gaps in the data stream still exist. Until such gaps are filled the results reported herein can only be regarded as preliminary.

All imagery received to date are recorded on ground track maps in Appendix C. The lake freeze season, which ostensibly begins during cycle 3, (September 11-September 28) is represented by only a few scattered swaths. Imagery from the northern latitudes (> 60°N) is notably lacking at this time.

Despite the shortage of pertinent imagery an effort has been made to test the Data Analysis Plan and prove the feasibility of using satellite imagery to monitor lake ice conditions. By 30 November 1972 over 280 individual lake observations had been made. Part of these observations as stored in the LOF is shown in Table 4. As evidenced by the observation code most of these data were acquired early in the season, prior to any notable freezing.

However, four swaths from northwest Canada for early October were found to contain excellent, relatively cloud-free images of the transition zone. Figure 7 shows the geographical extent of the zone as interpreted from the imagery. The coverage period began October 5 and ended October 11. Limits of the transition zone as observed from the imagery are depicted by solid lines, inferred limits by dashed lines. In spite of the meager data some interesting observations were made. First, the transition zone is apparently more complex than had been anticipated. The imagery indicate more than one area of active freezing, rather than a single, continuous zone. In this case, many lakes west of Great Slave Lake were found to be frozen although the main body of the transition zone lay farther to the north. The data are as yet much too sparse to produce an explanation for this phenomenon, however, there is [redacted]able[redacted] [redacted]rtion[redacted]f [redacted]ake Ob[redacted]vat[redacted]n [redacted]ile

	OBS DAT	IMAGE	LAKE NAME	LAKE ID	LAT	LONG	S/P	OBS CODE	COMMENTS
57	82872	6145	PARTRIDGE	141421	4417	8853	WIS	A000	
58	82872	6145	WHITE	141431	4422	8855	WIS	A000	
59	82872	6145	SINNISSIPPI	141441	4332	8337	WIS	A000	
60	82872	6145	PUCKAWAY	141451	4345	8912	WIS	A000	
61	82872	6145	POYGAN	141461	4409	8850	WIS	A000	
62	82872	6145	RUSH	141471	4356	8849	WIS	A000	
63	82872	6152	DEVILS	140073	4325	8944	WIS	A000	
64	82872	6152	KEGONSA	140123	4258	8915	WIS	A000	
65	82872	6152	MENDOTA	140153	4307	8925	WIS	A000	
66	82872	6152	MONONA	140183	4304	8922	WIS	A000	
67	82872	6152	ROCK	140213	4305	8854	WIS	A000	
68	82872	6152	WAUBESA	140273	4301	8919	WIS	A000	
69	82872	6152	WINGRA	140305	4303	8925	WIS	A000	
70	82872	6152	KOSHKONONG	140951	4252	8858	WIS	A000	
71	82872	6154	SENACHWINE	060041	4110	8921	ILL	A000	
72	82872	6154	GOOSE	060051	4114	8923	ILL	A000	
73	82872	6154	SPRING	060091	4202	9008	ILL	A000	
74	82872	6161	CHAUTAUQUA	060081	4022	9000	ILL	A000	
75	82872	6161	CLEAR	060141	4025	8957	ILL	A000	
76	82872	7535	RICHARDS	030540	5910	10710	SAS	A000	
77	82872	7535	DAVY	030570	5852	10818	SAS	A000	SAND DUNES NEAR ATHABASCA
78	82872	7551	COLD	020014	5425	11017	ALB	0500	
79	82872	7551	WOLF	020110	5441	11058	ALB	A000	
80	82872	7562	NEWELL	020100	5026	11157	ALB	A000	
81	82972	6181	ATTAWAPISKAT	050114	5214	8753	ONT	C700	CIDS OPAQUE
82	82972	6190	NIPIGON	050250	4950	8830	ONT	A000	
83	82972	6195	GOGEBIC	090220	4632	8935	MCH	A000	
84	82972	6201	BUTTERNUT	140611	4558	9031	WIS	A000	
85	82972	6201	NAMEKAGON	140671	4612	9107	WIS	A000	
86	82972	6201	LONG	140751	4515	9124	WIS	C600	CIDS OPAQUE
87	82972	6201	WISSOTA	140761	4457	9120	WIS	C600	CIDS OPAQUE
88	82972	6201	ISLAND	141121	4519	9123	WIS	C200	
89	82972	6201	CHIPPEWA	141171	4556	9110	WIS	A000	
90	82972	6201	LOST LAND	141181	4606	9109	WIS	A000	
91	82972	6201	MOOSE	141191	4601	9102	WIS	A000	
92	82972	6201	TEAL	141231	4605	9107	WIS	A000	
93	82972	6204	ARBUTUS	140771	4426	9042	WIS	A000	
94	82972	6204	ALTOONA	140881	4449	9126	WIS	A000	
95	82972	6204	REDSTONE	141131	4337	9006	WIS	A000	
96	82972	6213	MAC BRIDE	080051	4148	9134	IWA	A000	SAME AS 080061 ?
97	82972	6213	CORALVILLE	080061	4143	9132	IWA	A000	SAME AS 080051 ?
98	82972	6213	RATHBUN	080081	4050	9254	IWA	A000	
99	82972	7582	BEAVERHILL	010380	6248	10422	NWT	C800	
100	82972	8003	WINEFRED	020120	5530	11030	ALB	C500	
101	82972	8005	LAC LA BICHE	020064	5446	11158	ALB	C100	
102	82972	8005	MOOSE	020130	5415	11055	ALB	A000	
103	83072	6252	NYM	050034	4845	9137	ONT	0500	NE-SW LNS Q OVR LND
104	83072	6252	SHELL	140233	4544	9154	WIS	C600	
105	83072	6252	SPOONER	140243	4550	9149	WIS	C200	
106	83072	6252	LOWER EAU CLAIRE	140651	4616	9133	WIS	C800	
107	83072	6252	MIDDLE EAU CLAIR	140661	4613	9131	WIS	C800	
108	83072	6252	NAMEKAGON	140571	4612	9107	WIS	C500	
109	83072	6252	UPPER EAU CLAIRE	140691	4619	9129	WIS	C800	
110	83072	6252	HARDON	140821	4613	9153	WIS	C600	
111	83072	6252	NEBAGAMON	140841	4630	9143	WIS	C200	
112	83072	6252	ST CROIX FLOWAGE	140851	4615	9152	WIS	C700	
113	83072	6252	GRINDSTONE	141141	4555	9125	WIS	C600	
114	83072	6252	LAC COURT OREILL	141151	4554	9126	WIS	C900	

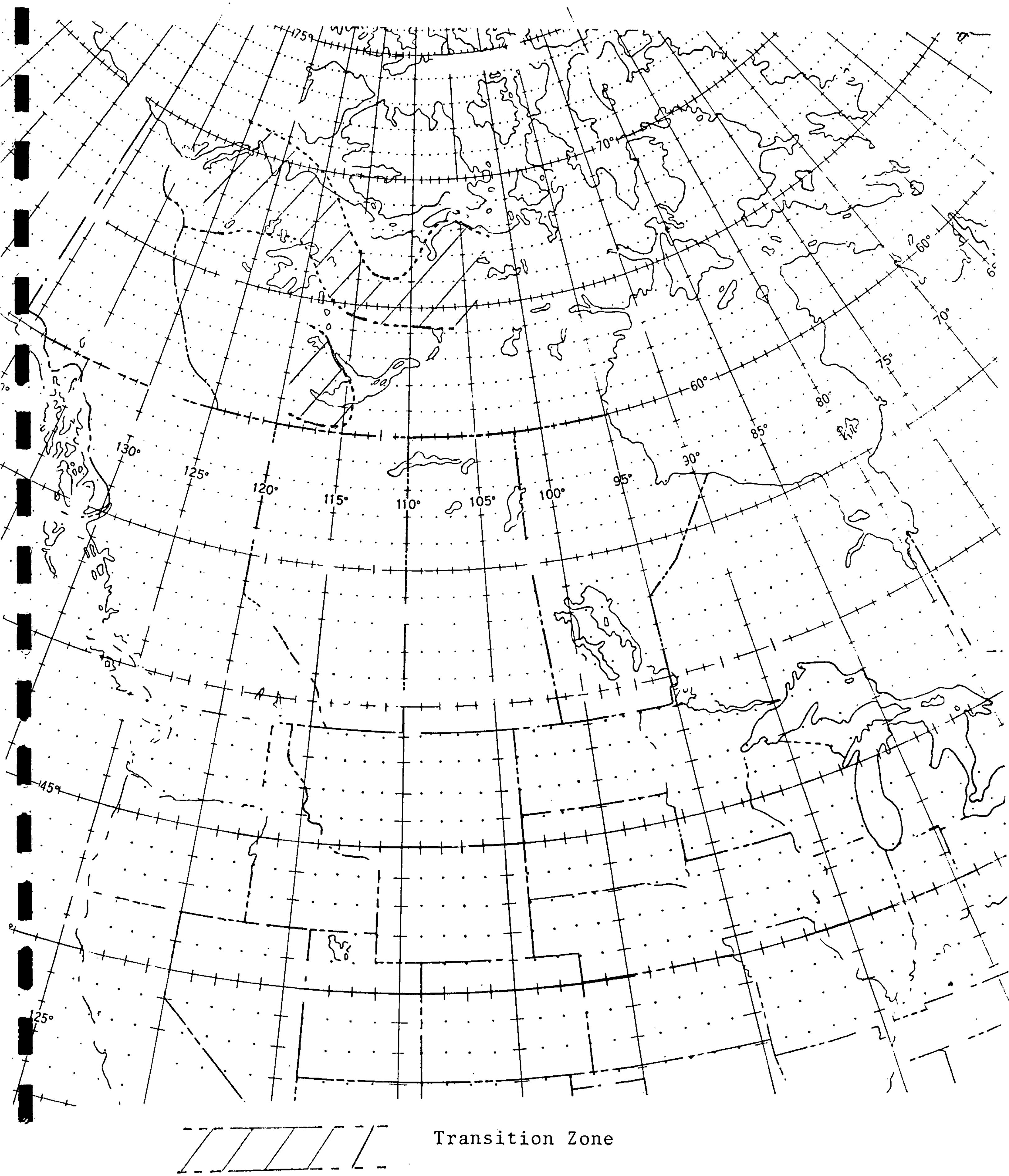


Figure 7. Observed Lake Transition Zone
(05 Oct 72-11 Oct 72)

every suggestion that the large lakes of northwest Canada, Great Bear Lake and Great Slave Lake, exert a strong moderating influence on the climate in their vicinity, which may hinder southward migration of the transition zone. Early October weather records for Great Slave Lake show stations on or near the lake having minimum temperatures 3 to 10°F higher than at a station about 100 miles to the west. This fact, coupled with the apparent swing of the transition zone to the north of Great Bear Lake offer strong indications that thermal inertia in the large lakes plays a major role in governing transition zone migration.

Once again it must be emphasized that the results reported herein are strictly tentative and subject to revision as additional data becomes available.

SECTION 4.0
PROJECTED WORK

During the next reporting period the following tasks are scheduled for action:

- Data Analysis Software Development
- Continued ERTS Imagery and Data Analysis

As explained in Section 3.0 the first of these tasks is a carryover from the Prelaunch Phase of the investigation. The software routines will be confined to those of a computational variety for analytical assistance rather than graphical displays as had originally been planned. The bulk of the effort for the next reporting period and the remainder of the investigation will consist of continued imagery and data analysis following the procedures outlined in the Data Analysis Plan. Each spectral band will be critically examined to select the optimum band for use in future analysis efforts.

SECTION 5.0
CONCLUSIONS

The work performed during the first two phases of this investigation has established the soundness of the Data Analysis Plan. Implementation and testing of this plan's procedures have resulted in proven capability for handling heavy ERTS 1 data loads. The semi-automated approach to data processing and analysis appears more than adequate at this time.

Preliminary results indicate that all stated objectives of this investigation can be met provided a high percentage of test site coverage by ERTS 1 is attained. As indicated by Appendix C, there still remain considerable gaps in the coverage record.

Opaque cloud cover is an external problem over which neither NASA nor the Principal Investigator has any control. Interference due to cloud cover has affected preliminary data analysis and will probably contribute a degree of uncertainty to a fair portion of future results.

The extent to which the above problems may hamper orderly progress of this investigation is unknown. However, on the basis of accomplishments to date there is every indication that their overall effect will be minor. At this juncture we can only recommend that work proceed as scheduled.

SECTION 6.0
REFERENCES

1. Allen, W.T.R. and B.S.V. Cudbird, Freezings and breakup dates of water bodies in Canada, Can. Met. Serv., CLI-1-71, 144 p., 1971.

2. Ragotzkie, R.A., Compilation of freezing and thawing dates for lakes in north central United States and Canada, Tech. Report 3, NONR 1202(07), 61 p., 1960.

3. Birge, E.A. and C. Juday, The inland lakes of Wisconsin: hydrography and morphometry, Wis. Geol. Nat. Hist. Serv., 27, 137 p., 1914.

4. Rawson, D.S., A limnological comparison of 12 large lakes in northern Saskatchewan, Limn. Ocean., 5, 195-211, 1960.

5. Koshinsky, G.D., The morphometry of shield lakes in Saskatchewan, Limn. Ocean., 15, 695-701, 1970.

APPENDIX A
STUDY LAKE DIRECTORY

****** LAKE DIRECTORY ******

	LAKE NAME	ID CODE	S/P	LATITUDE DEG MIN	LONGITUDE DEG MIN
1	BAKER	010034	NWT	6412	9530
2	UN-NAMED	010054	NWT	6845	10904
3	DOG POND	010065	NWT	6320	9043
4	MISSION	010074	NWT	6320	9043
5	POLICE	010085	NWT	6320	9043
6	UN-NAMED	010095	NWT	6912	11838
7	UN-NAMED (2)	010104	NWT	6935	12045
8	CONTWOYTO	010114	NWT	6529	11022
9	ENNADAI	010124	NWT	6108	10055
10	GREATSLAVE/MCLOU	010134	NWT	6243	10906
11	GREATSLAVE/CHARL	010144	NWT	6243	10906
12	GREATSLAVE/RESO	010154	NWT	6111	11341
13	UN-NAMED	010164	NWT	6840	9748
14	UN-NAMED	010194	NWT	6839	10144
15	MODULE	010214	NWT	6830	11313
16	BAGNELL	010224	NWT	6818	8541
17	LAKE BARROW	010254	NWT	6826	8939
18	GREAT BEAR	010264	NWT	6605	11802
19	UN-NAMED	010275	NWT	6835	11106
20	UN-NAMED	010304	NWT	6849	9325
21	FRAME	010324	NWT	6228	11427
22	LONG	010334	NWT	6228	11427
23	COLD	020014	ALB	5425	11017
24	PRIMROSE	020024	ALB	5425	11017
25	ATHABASCA	020044	ALB	5843	11109
26	BEAR	020054	ALB	5511	11853
27	LAC LA BICHE	020064	ALB	5446	11158
28	LESSER SLAVE	020074	ALB	5521	11459
29	LAKE MINNEWANKA	020084	ALB	5111	11534
30	GLENMORE RESERVO	020094	ALB	5106	11401
31	CANOE	020105	ALB	5425	11017
32	FROBISHER	030011	SAS	5619	10757
33	JAN	030041	SAS	5455	10255
34	MIROND	030051	SAS	5507	10247
35	PELICAN	030061	SAS	5509	10300
36	MCINTOSH	030071	SAS	5550	10500
37	WILDNEST	030101	SAS	5500	10220
38	ANNABEL	030151	SAS	5450	10213
39	JOHNSON	030181	SAS	5451	10217
40	TYRELL	030191	SAS	5453	10208
41	CONTACT	030231	SAS	5613	10343
42	WOLLASTON	030351	SAS	5815	10320
43	AMISK	030361	SAS	5433	10215
44	BIG PETER POND	030371	SAS	5600	10850
45	LITTLE PETER PON	030381	SAS	5547	10835
46	ILE A LA CROSSE	030391	SAS	5527	10750
47	EKAPO	030414	SAS	5023	10235
48	CHURCHILL	030422	SAS	5551	10827
49	CREE	030432	SAS	5721	10650
50	LAC LA RONGE	030442	SAS	5508	10520
51	MEADOW	030454	SAS	5407	10826
52	WASCANA	030464	SAS	5026	10440
53	BEAVERLODGE	030472	SAS	5934	10829
54	BIG QUILL	030484	SAS	5146	10412
55	YORK	030494	SAS	5116	10228

	LAKE NAME	ID CODE	S/P	LATITUDE DEG MIN	LONGITUDE DEG MIN
56	REINDEER	C30501	SAS	5720	10220
57	FARNSWORTH	C40014	MAN	5845	9404
58	ATHAPAPUSKOW	C40023	MAN	5437	10121
59	LAKE DAUPHIN	C40043	MAN	5106	10003
60	SCHIST	C40052	MAN	5441	10141
61	LAKE WINNIPEG	C40082	MAN	5038	9703
62	HEMING	C40093	MAN	5453	10107
63	LYNN	C40102	MAN	5652	10104
64	ELDON	C40112	MAN	5652	10104
65	LAKE MANITOBA	C40123	MAN	5009	9830
66	LITTLE PLAYGREEN	C40134	MAN	5359	9750
67	LAKE WAHTOPANAH	C40144	MAN	5001	10019
68	CLEARWATER	C40152	MAN	5402	10101
69	GRACE	C40164	MAN	5350	10110
70	SETTING	C40172	MAN	5455	9838
71	WINNIPEGOSIS	C40183	MAN	5139	9955
72	BRERETON	C40193	MAN	4954	9435
73	CADDY	C40203	MAN	4949	9443
74	FALCON	C40213	MAN	4942	9515
75	WEST HAWK	C40223	MAN	4946	9511
76	BARRINGTON	C40233	MAN	5656	10015
77	CEDAR	C40243	MAN	5316	10009
78	CROSS	C40253	MAN	5444	9730
79	GOOSE	C40263	MAN	5423	10125
80	GRANVILLE	C40273	MAN	5618	10030
81	ROCKY	C40303	MAN	5409	10130
82	SOUTH INDIAN	C40313	MAN	5720	9820
83	SPLIT	C40323	MAN	5613	9617
84	WALKER	C40333	MAN	5443	9700
85	WATERHEN	C40343	MAN	5207	9935
86	WHEATCROFT	C40353	MAN	5649	10101
87	WHITE	C40373	MAN	5002	9533
88	ZED	C40383	MAN	5655	10124
89	RICE	C40394	MAN	5102	9540
90	REINDEER/BROCHET	C40402	MAN	5753	10141
91	ISLAND	C40414	MAN	5352	9440
92	RANDOLPH	C50024	ONT	5017	8854
93	NYM	C50034	ONT	4845	9137
94	PLATEAU	C50044	ONT	4845	9137
95	STEEP ROCK	C50054	ONT	4845	9137
96	LAKE KENOGAMISIS	C50064	ONT	4941	8657
97	KENOGAMISIS/BART	C50074	ONT	4941	8657
98	LAKE OF THE WOOD	C50104	ONT	4948	9422
99	ATTAWAPISKAT	C50114	ONT	5214	8753
100	PICKLE	C50134	ONT	5127	9012
101	RED	C50144	ONT	5104	9349
102	PELICAN	C50164	ONT	5007	9154
103	BIG TROUT	C50174	ONT	5350	8952
104	PICNIC	C50204	ONT	4836	8517
105	TOOKENAY	C50214	ONT	4836	8517
106	SENACHWINE	C60041	ILL	4110	8921
107	GOOSE	C60051	ILL	4114	8923
108	PISTAKEE	C60061	ILL	4223	8812
109	HORSESHOE	C60071	ILL	3842	9005
110	CHAUTAUQUA	C60081	ILL	4022	9000
111	SPRING	C60091	ILL	4202	9008
112	FOX	C60101	ILL	4225	8809

	LAKE NAME	ID CODE	S/P	LATITUDE DEG MIN	LONGITUDE DEG MIN
113	CALUMET	060111	ILL	4140	8735
114	CLEAR	060141	ILL	4025	8957
115	VERMILLION	060151	ILL	4011	8738
116	WAWASEE	070021	IND	4124	8542
117	WINONA	070031	IND	4113	8550
118	CEDAR	070051	IND	4122	8726
119	SYRACUSE	070061	IND	4125	8544
120	MAC BRIDE	080051	IWA	4148	9134
121	CORALVILLE	080061	IWA	4143	9132
122	RED ROCK	080071	IWA	4122	9259
123	RATHBUN	080081	IWA	4050	9254
124	UNION	090071	MCH	4203	8512
125	BEAR	090103	MCH	4448	8437
126	BIG PORTAGE	090113	MCH	4219	8415
127	FINE	090133	MCH	4227	8517
128	MUSKEGON	090211	MCH	4314	8618
129	BIG STONE	100031	MIN	4519	9627
130	BUFFALO	100041	MIN	4510	9354
131	SHAGAWA	100051	MIN	4755	9154
132	HAGEN	110031	NEB	4220	9944
133	MOON	110041	NEB	4223	10008
134	WILLOW	110051	NEB	4214	10005
135	BIG ALKALI	110091	NEB	4238	10037
136	DADS	110111	NEB	4230	10040
137	MARSH	110151	NEB	4230	10030
138	PELICAN	110181	NEB	4232	10039
139	RED DEER	110201	NEB	4234	10029
140	SWAN	110211	NEB	4214	10046
141	TROUT	110221	NEB	4235	10037
142	CRESCENT	110251	NEB	4142	10224
143	GOOSE	110261	NEB	4147	10227
144	ISLAND	110281	NEB	4144	10224
145	GEORGE	110291	NEB	4159	10150
146	SWAN	110311	NEB	4143	10230
147	ASHTABULA	120011	NDA	4710	9800
148	SPIRITWOOD	120021	NDA	4711	9850
149	SAKAKAWEA	120031	NDA	4735	10125
150	HEART BUTTE	120051	NDA	4636	10150
151	JAMESTOWN	120061	NDA	4656	9842
152	BIG STONE	130011	SDA	4518	9628
153	LAKE HERMAN	130021	SDA	4400	9710
154	LAKE MADISON	130031	SDA	4357	9700
155	LAKE KAMPESKA	130041	SDA	4455	9712
156	LAKE POINSETT	130051	SDA	4434	9705
157	LAKE ANDES	130061	SDA	4309	9830
158	LAKE OAHE	130071	SDA	4428	10030
159	LAKE SHARPE	130081	SDA	4348	9923
160	FRANCIS CASE	130091	SDA	4304	9835
161	LEWIS & CLARK	130101	SDA	4251	9730
162	SHADEHILL	130111	SDA	4545	10213
163	BEAVER DAM	140013	WIS	4330	8852
164	ARBOR VITAE	140023	WIS	4558	8939
165	CAMP	140043	WIS	4232	8808
166	CHAIN-O-LAKES	140053	WIS	4420	8910
167	DEVILS	140073	WIS	4325	8944
168	GENEVA	140093	WIS	4234	8830
169	ISLAND	140103	WIS	4608	8947

	LAKE NAME	ID CODE	S/P	LATITUDE DEG MIN	LONGITUDE DEG MIN
170	KEGONSA	140123	WIS	4258	8915
171	MENDOTA	140153	WIS	4307	8925
172	MONONA	140183	WIS	4304	8922
173	NAGAWICKA	140193	WIS	4305	8823
174	ROCK	140213	WIS	4305	8854
175	SHELL	140233	WIS	4544	9154
176	SPOONER	140243	WIS	4550	9149
177	SUMMIT	140253	WIS	4628	9215
178	TROUT	140263	WIS	4603	8940
179	WAUBESA	140273	WIS	4301	8919
180	WINGRA	140305	WIS	4303	8925
181	WINNEBAGO	140313	WIS	4400	8824
182	BONE	140353	WIS	4532	9223
183	BROWNS	140373	WIS	4241	8815
184	MUD	140423	WIS	4242	8808
185	TURTLE	140453	WIS	4614	8915
186	PEWAUKEE	140473	WIS	4305	8817
187	PINE	140481	WIS	4307	8823
188	NORTH(EAST)	140491	WIS	4309	8823
189	NORTH(WEST)	140501	WIS	4309	8823
190	OKAUCHEE	140511	WIS	4308	8826
191	OCONOMOWOC(MAIN)	140521	WIS	4306	8828
192	FOWLER	140531	WIS	4307	8830
193	LAC LA BELLE	140541	WIS	4308	8831
194	SILVER	140551	WIS	4305	8830
195	DELAVAN	140561	WIS	4237	8836
196	GREEN	140571	WIS	4349	8900
197	BEULAH(4BASINS)	140581	WIS	4249	8823
198	BIG CEDAR	140591	WIS	4323	8816
199	BUTTERNUT	140611	WIS	4558	9031
200	BEAR	140621	WIS	4538	9149
201	PRAIRIE	140631	WIS	4522	9141
202	RED CEDAR	140641	WIS	4536	9135
203	LOWER EAU CLAIRE	140651	WIS	4616	9133
204	MIDDLE EAU CLAIR	140661	WIS	4618	9131
205	NAMEKAGON	140671	WIS	4612	9107
206	UPPER EAU CLAIRE	140691	WIS	4619	9129
207	BIG SAND	140711	WIS	4550	9213
208	CLAM	140721	WIS	4548	9220
209	YELLOW	140731	WIS	4555	9224
210	LONG	140751	WIS	4515	9124
211	WISSOTA	140761	WIS	4457	9120
212	ARBUTUS	140771	WIS	4426	9042
213	FOX	140801	WIS	4335	8856
214	BARDON	140821	WIS	4613	9153
215	NEBAGAMON	140841	WIS	4630	9143
216	ST CROIX FLOWAGE	140851	WIS	4615	9152
217	ALTOONA	140881	WIS	4449	9126
218	EAU CLAIRE	140891	WIS	4446	9106
219	BUTTERNUT	140901	WIS	4555	8900
220	FRANKLIN	140911	WIS	4556	8900
221	KENTUCK	140921	WIS	4559	8900
222	PINE	140941	WIS	4541	8859
223	KOSHKONONG	140951	WIS	4252	8858
224	CALDRON FALLS RE	140961	WIS	4521	8815
225	HIGH FALLS RESER	140971	WIS	4519	8811
226	CLEAR	140991	WIS	4552	8938

D

	LAKE NAME	ID CODE	S/P	LATITUDE DEG MIN	LONGITUDE DEG MIN
227	PELICAN	141001	WIS	4530	8912
228	SQUIRREL	141021	WIS	4552	8954
229	TOMAHAWK	141031	WIS	4550	8940
230	THUNDER	141041	WIS	4547	8913
231	BALSAM	141051	WIS	4528	9226
232	BIG ROUND	141061	WIS	4532	9219
233	CEDAR	141071	WIS	4513	9235
234	WAPOGASSET	141081	WIS	4520	9226
235	PIKE	141091	WIS	4554	9004
236	ISLAND	141121	WIS	4519	9123
237	REDSTONE	141131	WIS	4337	9006
238	GRINDSTONE	141141	WIS	4556	9125
239	LAC COURT OREILL	141151	WIS	4554	9126
240	CHETEC	141161	WIS	4542	9130
241	CHIPPEWA	141171	WIS	4556	9110
242	LOST LAND	141181	WIS	4606	9109
243	MOOSE	141191	WIS	4601	9102
244	NELSON	141201	WIS	4605	9123
245	ROUND	141211	WIS	4601	9119
246	SPIDER	141221	WIS	4606	9114
247	TEAL	141231	WIS	4605	9107
248	SHAWAND	141241	WIS	4448	8832
249	BIG ST GERMAIN	141251	WIS	4556	8931
250	BIG MUSKELLUNGE	141261	WIS	4601	8937
251	BIG SAND	141271	WIS	4604	8859
252	CRAWLING STONE	141291	WIS	4656	8953
253	FENCE	141301	WIS	4557	8951
254	IKE WALTON	141321	WIS	4602	8948
255	LAC VIEUX DESERT	141331	WIS	4608	8907
256	PRESQUE ISLE	141351	WIS	4613	8947
257	COMO	141371	WIS	4236	8830
258	NANCY	141401	WIS	4606	9200
259	PARTRIDGE	141421	WIS	4417	8853
260	WHITE	141431	WIS	4422	8856
261	SINNISSIPPI	141441	WIS	4322	8837
262	PUCKAWAY	141451	WIS	4345	8912
263	POYGAN	141461	WIS	4409	8850
264	RUSH	141471	WIS	4356	8848
265	POTATO	141481	WIS	4519	9126
266	METONGA	141491	WIS	4532	8855
267	WILLOW RESERVOIR	141501	WIS	4543	8954
268	NORTH TWIN	141511	WIS	4603	8908

****** END OF FILE ******

APPENDIX B
ERTS IMAGERY FILING INSTRUCTIONS

ERTS IMAGERY FILING INSTRUCTIONS

Step-by-Step Approach to Proper Filing of ERTS Imagery

Task 1: Sort ERTS Imagery

a. Open package.

b. Discard packing envelope, cardboard, and xerox sheet (if included).

c. Set aside postcard form.

d. Check computer printout for total number of images and image ID's.
IMPORTANT: If image ID's indicate all images were taken on the same day during the same hour, all images probably belong to a single swath and will be relatively easy to sort. However, if images were not taken the same day and/or the same hour, two or more satellite swaths are represented in the package. Greater care must be exercised during sorting.

e. Sort image transparencies according to band (4,5,6, and 7) into the corresponding labeled partitions.
IMPORTANT: Always handle transparencies along edges to minimize fingerprint contamination.

f. Sort image transparencies for each band, increasing sequentially according to the microfilm number printed on the left side of each image.
NOTE: If more than one swath is present, they will have to be separated before proceeding.

g. If all images present and accounted for, check and sign postcard form; if not, make comment in notebook (ERTS Image Log, see Task 2(b)).

Task 2: Image Recording and Cloud Cover Estimation

a. Record date of imagery on top right-hand corner, page 1, of computer printout.

b. Make an entry (Log Date, Image Date) in ERTS Image Log along with any comments from Task 1(g).

c. Correlate image ID numbers for the first image of every band with those shown on the computer printout; record the microfilm number corresponding to the appropriate image on the printout.

d. To begin cloud cover estimation, remove band 5 images from partition, switch on light table, and make a cloud cover column on available space on computer printout.

e. View each image sequentially, estimate percent clouds to nearest 10, and record in cloud cover column opposite appropriate image ID. (Often you can see through high, thin clouds; this is not considered cloud cover.)

Task 3: Swath Recording and Filing

a. The coverage extent of the swath must be recorded on the ERTS 1 Ground Track Maps. This will be done in duplicate: original and working copy.

b. Turn to Ground Track Map section of notebook and find image date on appropriate map.

c. Using red ballpoint and ruler, draw line along orbit day corresponding to satellite swath coverage. Swath coverage is given by the latitude-longitude of image center printed on each transparency. Only the first and last images of a swath need be used.

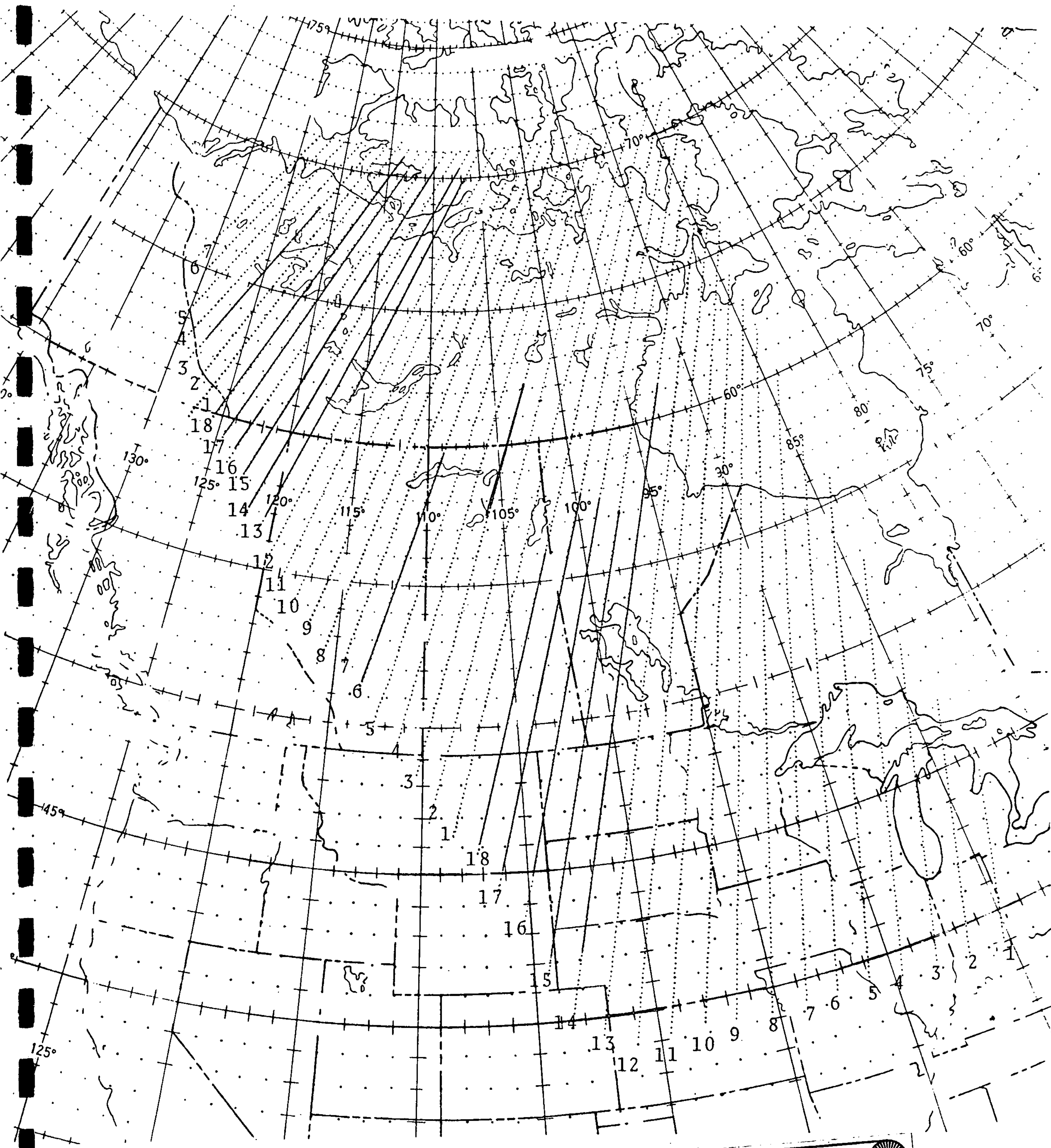
d. Repeat (c) on original copy in bin.

e. Combine all transparencies (band 4 on top) and return to glassine envelope.

f. Separate original and carbon computer printout: staple, 3-hole punch, and file original in notebook; file carbon with transparencies in file folder showing date of imagery.

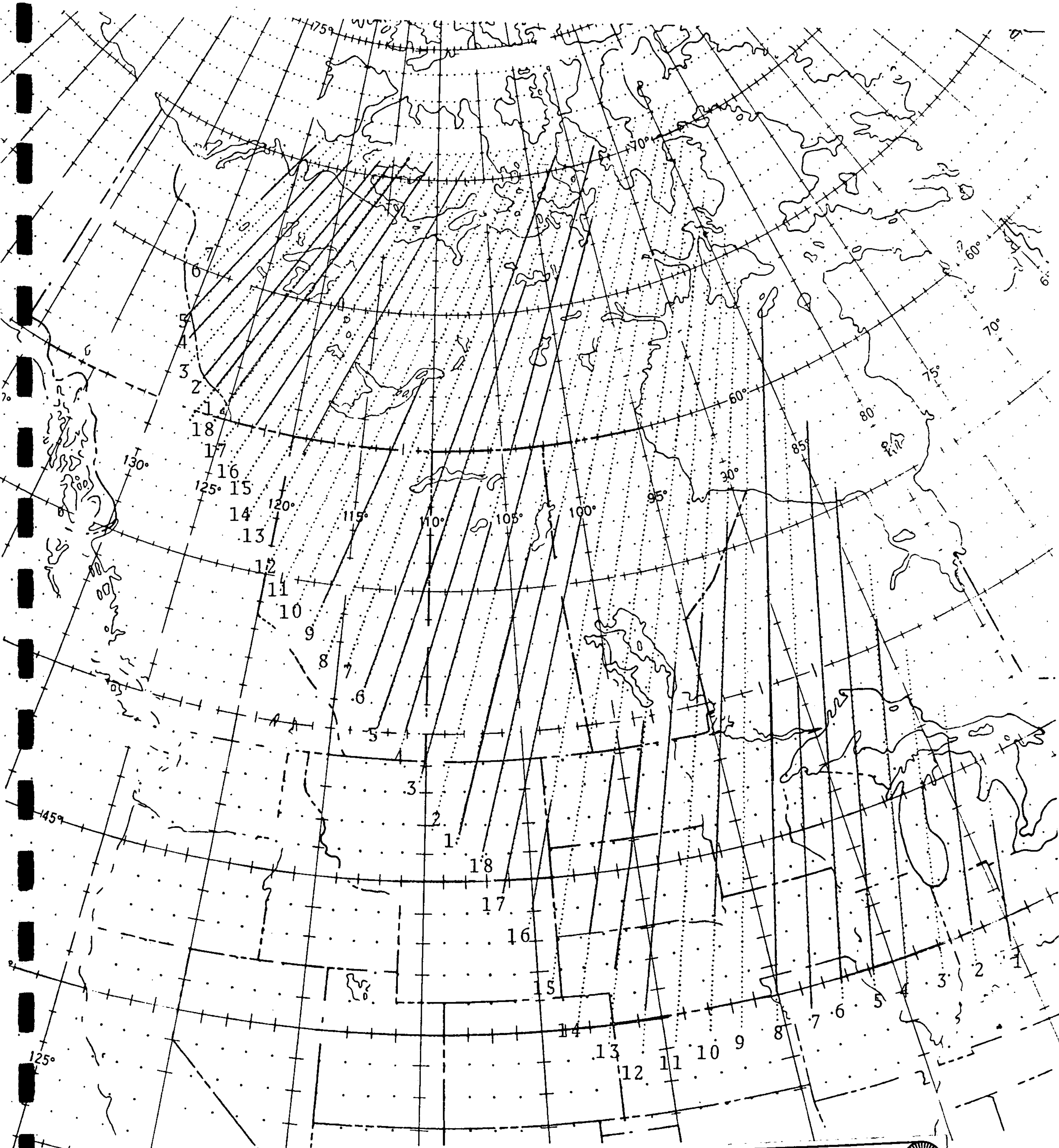
g. Finished! However, if more than one imagery date and/or swath is involved, you must go back and repeat Tasks 2 and 3 for each additional swath. Extra glassine envelopes are available, but you may have to duplicate the printout.

APPENDIX C
ERTS IMAGERY INVENTORY



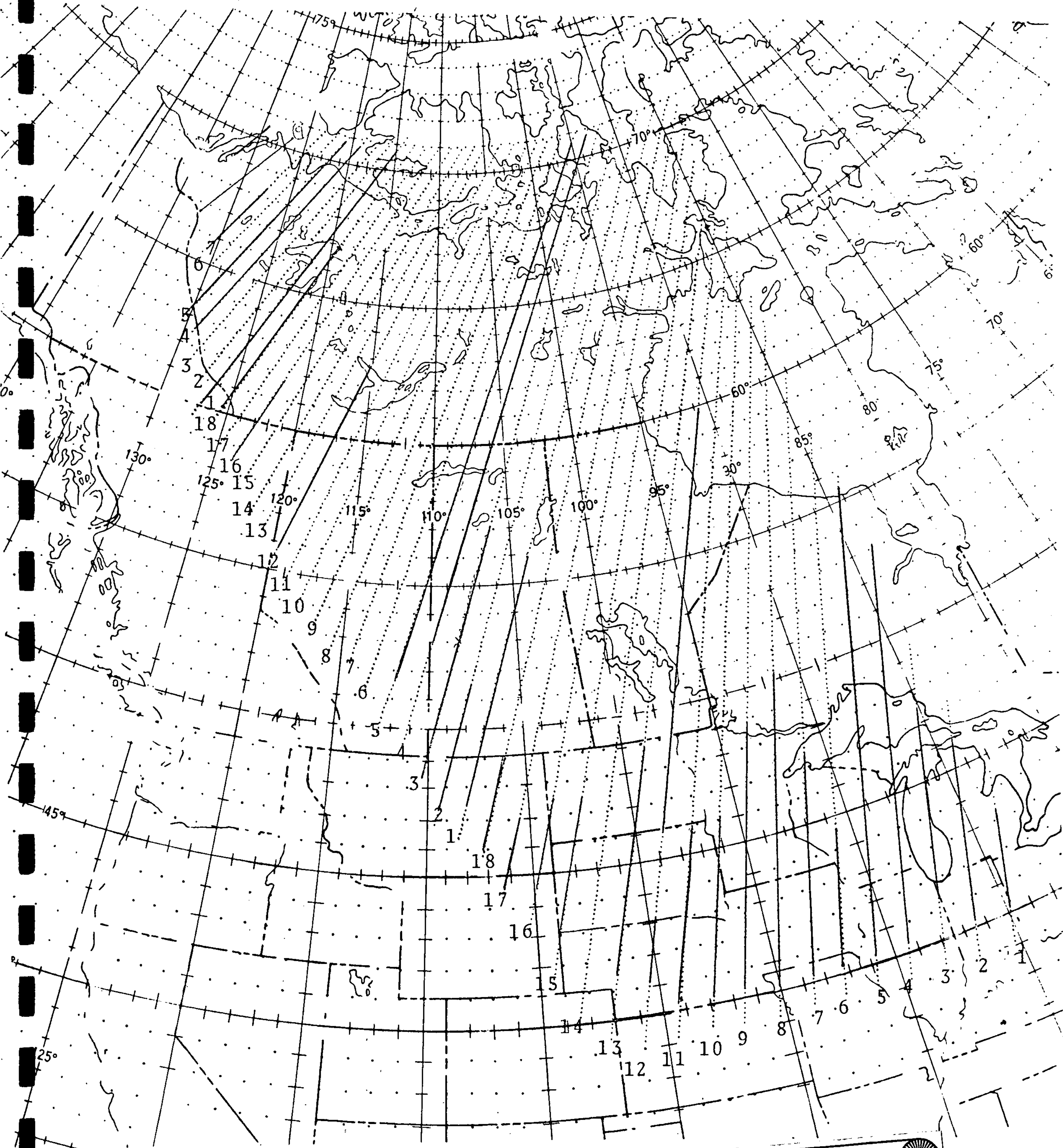
ERTS 1 GROUND TRACKS

CYCLE 1 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE AUG	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23



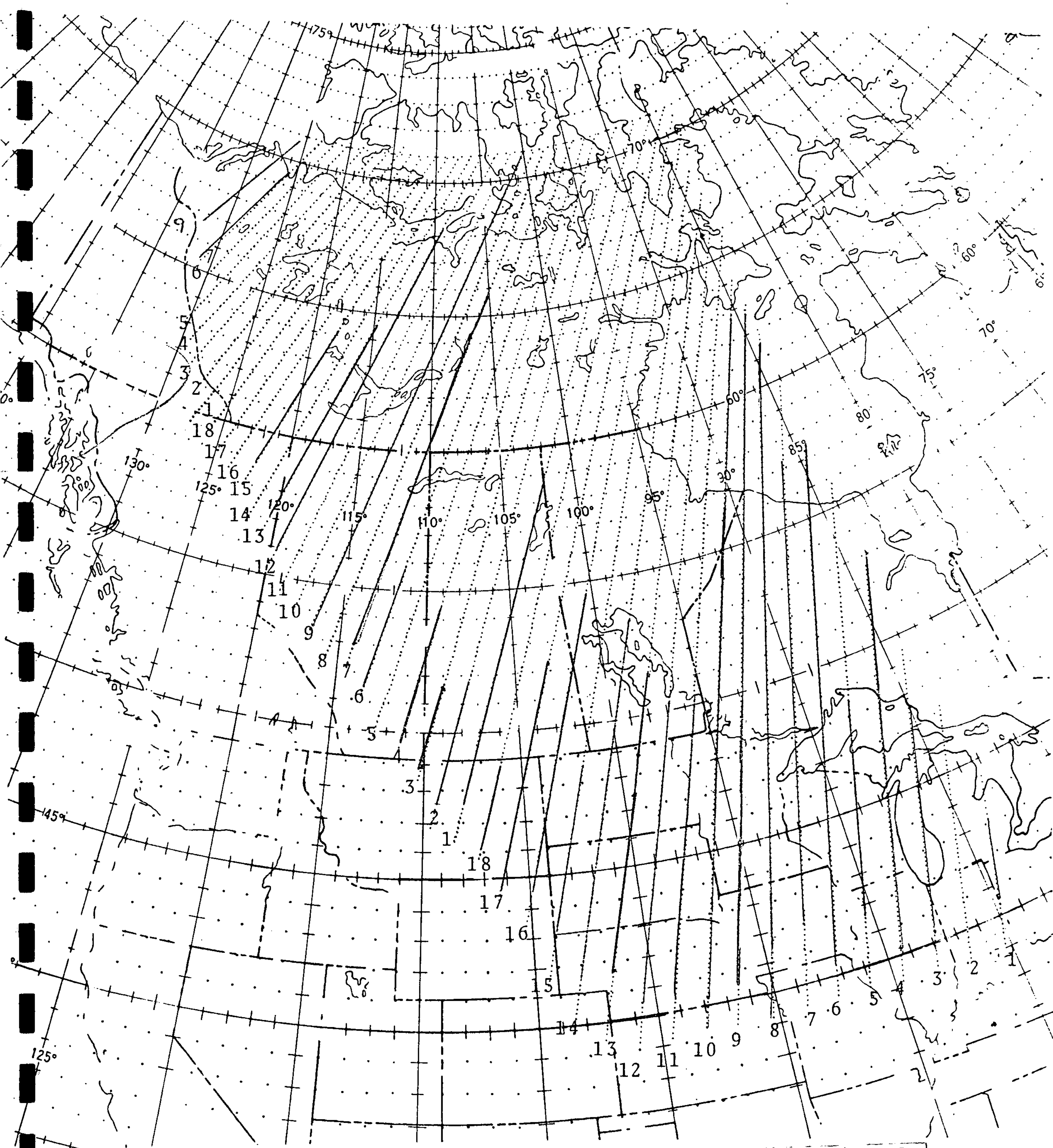
ERTS 1 GROUND TRACKS

CYCLE 2 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE AUG	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10



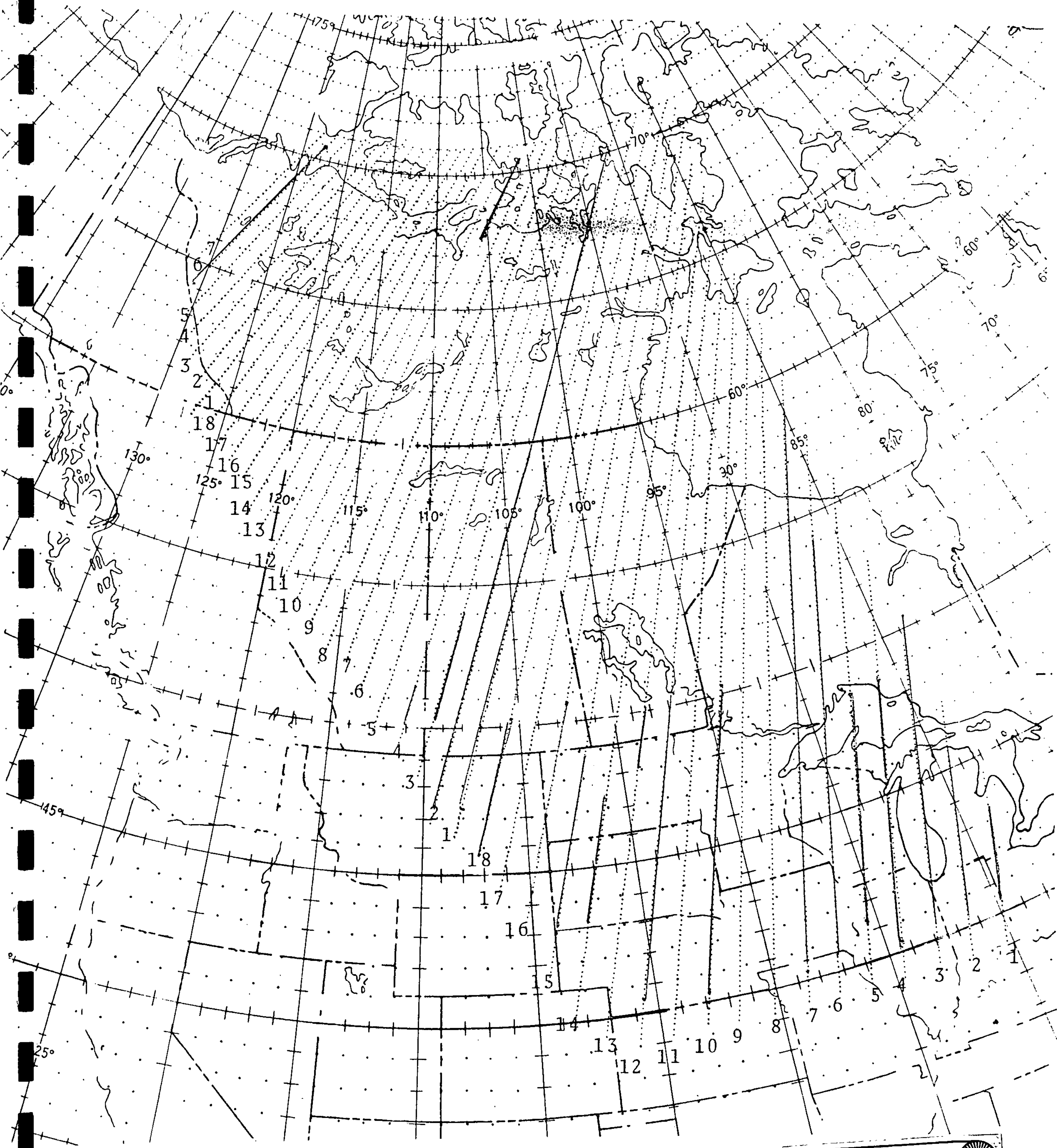
ERTS 1 GROUND TRACKS

CYCLE 3 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE SEP	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28



ERTS 1 GROUND TRACKS

CYCLE 4 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE --SEP	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16



ERTS 1 GROUND TRACKS

CYCLE 5 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE OCT	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3